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The mental health of university students is a mounting topic of concern. With the rise in students self-reporting an increase in mental health distress, steps need to be taken to provide accessible intervention methods. According to the National College Health Assessment (2018), university students are experiencing various forms of mental health issues ranging from feeling overwhelmed (85%), to feeling so depressed that it was difficult to function (41.4%). Meditation in nature and exposure to nature can be beneficial to mental health by lowering depression, anxiety, and stress, due in part to people's innate connection to nature called biophilia (Pasanen, Tyrväinen & Korpela, 2014).

This research sought out to expand upon existing claims that dynamic meditation in a virtual setting can positively impact university student's perceived depression, anxiety, and stress. A paper-based questionnaire as well as two active meditation sessions in a designed virtual environment were used to collect data from thirty-one university students from the department of Interior Architecture attending the University of North Carolina Greensboro. The questionnaire consisted of five demographic questions as well as the Perceived Stress Scale (PSS) and the Depression Anxiety Stress Scale (DASS). The questionnaire was administered as a pre and posttest. The virtual environment consisted of six biomes that were designed based on the biophilic elements of design. Ambient sounds of nature were mapped throughout the space as well as dynamic elements such as waterfalls, mist, and animals frolicking throughout. All of this allowed for a fully immersed experience for participants.

The results indicated that after two sessions in the virtual environment, there was a statistically significant decrease in perceived depression, anxiety, and stress levels in participants. Considering these findings, providing students with an accessible intervention can improve their well-being.

EXPERIENCE AND EXPOSURE:

VIRTUAL REALITY AS A CONDUIT FOR ACTIVE MEDITATION

by

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CHAPTER I: INTRODUCTION

Stress is an inevitable part of life; however, it is becoming more prevalent among university students (Beiter, Nash, McCrady, Rhoades, Linscomb, Clarahan, & Sammut, 2015). With the recent outbreak of the Covid-19 virus, schools have had to juristically adjust the way they interact with and teach their classes. Students may need additional motivation, organization, and self-discipline to be successful amongst the constant changes and unknowns in their academic experience which can facilitate a rise in stress (Dumford & Miller, 2018). University students often lack a healthy balance between academics and leisure, which can plague students with crippling bouts of stress (Beiter et al. 2015). Not only do online courses limit students face to face and outdoor interactions, they rely solely on technologies that can and will fail. This can result in online courses causing stress for students (Dumford & Miller, 2018). Furthermore, the academic pressures of meeting course requirements, studying for exams, learning volumes of material and time management has been shown to be a significant source of stress (Beiter et al. 2015). It is, therefore, not surprising that 91% of university students report moderate to severe stress (American College Health Association [ACHA], 2018).

As students are affected by academic stress in university, anxiety is a health concern that can become crippling if left unattended. Anxiety disorders often begin early in life and constitute a significant risk for additional mental disorders such as depression (Rapee, 2015). The importance of understanding how stress and anxiety can impact university students is an issue that should be addressed. According to the National College Health Assessment (2018), students in four-year universities are experiencing various forms of mental health issues ranging from feeling overwhelmed (85%), to feeling so depressed that it was difficult to function (41.4%). This is not a new issue facing university students as the percentages of students' depression, anxiety and stress have increased since 2011 (ACHA, 2011; ACHA 2018). All courses carry a degree of difficulty, but students who are overloaded with academic work (e.g., classes,

assignments) experience more stress (Thomas & Borrayo, 2016). Courses that demand more time and dedication in and outside of class pit students against an inevitable outcome of increased stress exaggerating the rift in academic life and leisure. The impact of this unbalanced life related to the poor health rating of university students seen from 2011 to the increase in 2018 (ACHA, 2011, 2018). For instance, Architecture majors put in an average of 22.2 hours a week of study outside their classes while many nursing graduates have reported spending 18 – 25 hours per week in studying and clinical preparation (National Survey of Student Engagement [NSSE], 2017). Therefore, acknowledging the rift in academic life and leisure, and providing easily accessible ways for students to manage stress is essential in preventing further mental and physical health issues in university students.

One strategy aimed at improving mental health is practicing mindfulness, which can be described as the act of consciously focusing the mind on the present moment without judgment or attachment to the moment. (Haro, Hoyo, Campos, Linehan, Hoffman, Palacios, … Campayo, 2017). This can include strategies such as meditation and active/ dynamic meditation. Meditation is a holistic discipline by which the practitioner attempts to get beyond the reflexive, ‘‘thinking’’ mind into a deeper state of relaxation or awareness (Iqbal, Singh & Aleem, 2016). Active/dynamic meditation refers to any meditation technique which does not have one’s body assuming a static posture (Iqbal et al., 2016). Active meditation in nature and exposure to nature can be beneficial to mental health by lowering depression, anxiety, and stress, due in part to people’s innate connection to nature called biophilia (Pasanen, Tyrväinen & Korpela, 2014). Biophilia is the human tendency to interact or be closely associated with other forms of life in nature (Merriam Webster Dictionary, 1979). However, individuals do not always have access to nature, the time to put aside for it or the desire to go outside and experience it.

Nature provides a source of conciliation to the effects of mental illness, but it is up to the individual to pursue that exposure. Although, symptoms of depression may undermine

controlling forms of motivation, resulting in decreased moderate-to-vigorous physical activity (MVPA) (Scarapicchia, Sabiston, O'Loughlin, Brunet, Chaiton, & O'Loughlin, 2014). Research has shown that physical activity is inversely associated with stress, and that stress may impair efforts on adopting or maintaining healthy physical activity levels (Sampasa-Kanyinga & Chaput, 2016). This shows that stress can prevent us from being able to step away from work to immerse ourselves in nature. Stress and inability to step away from work can arise because of an individual's location, schedule, and work culture. Psychosocial factors at work are believed to be one of the main contributions to this increase in stress (Grahn, Palsdottir, Ottosson, & Jonsdottir, 2017). The geographic location a person resides in can limit access, such as a city with no green space or regions with unhealthy air quality. The World Health Organization (2013) recently listed outdoor air pollution as a carcinogen, and posits that one of eight deaths globally are caused by prolonged exposure to outdoor or indoor air pollution, or some combination thereof.

It is clear that university students are trying to cope with stresses of social and academic university life while leaving well-being as an afterthought. Therefore, this study seeks to explore whether active meditation in a virtual experience with simulated nature can have the same mental health affects as a physical walk in nature.

Research Questions

1. How can a virtual meditation experience impact university students' depression?
2. How can a virtual meditation experience impact university students' anxiety?
3. How can a virtual meditation experience impact university students' stress?
4. Can different biomes in the meditation experience promote more effective stress relief?
5. Can lighting effects influence participants' decisions on biome choice?

These questions will help assess the potential impacts virtual meditation may have on university students regarding depression, anxiety, and stress. Mindfulness and meditation are something that not everyone is attuned to or interested in pursuing because it is made out to be undesirable where everyone sits around and repeats the word “Om” in a mantra. Although, juxtaposed to this mindset, being able to focus on one thing allows you to clear your mind from all the constant thoughts making it easier to focus on your breathing and being conscious of your body.

It is important to understand the impact active meditation has on mental health. The demands and pressures of modern life are causes to some of the most threatening medical problems we face today. Chronic stress can suppress the immune system and trigger cardiovascular disease, stroke, depression, asthma, and other critical health problems (Jiang, Chang & Sullivan, 2014). There is mounting evidence stating exposure to nature enhances our ability to manage the demands and pressures of modern life (Jiang et al. 2014). This falls back to the connection we have with the natural environment, which is the idea of Biophilia. Settings that include tress, grass, and open spaces have been shown to aid physiological stress reduction (Jiang et al. 2014).

CHAPTER II: LITERATURE REVIEW

This chapter addresses three main sections. The first section focuses on the existing and increasing strain on student mental health and ways to mitigate the effects. The second section delves into meditation and mindfulness to get a better understanding of what they are, and the benefits associated with them. The final section takes a closer look at how nature affects our wellbeing and the important role it plays in our lives.

Strain on Student Mental Health

Depression, stress, and anxiety are components of mental health affecting university students at alarming rates (ACHA, 2018). Seven out of 10 adults in the U.S. claim to experience stress at a moderate level daily (Anxiety and Depression Association of America, n.d.). This moderate stress can increase throughout the day negatively impacting an individual's well-being. University students are also included in this data as the Franciscan University Counseling Center in Ohio has reported a 231% increase in yearly visits, as well as a 173% increase in total yearly clients since 2014 (Beiter, Nash, McCrady, Rhoades, Linscomb, Clarahan, & Sammut, 2015). Beiter et al. surveyed university students on their top concerns and found that academic performance, pressure to succeed, and post-graduation plans were the top stress inducing concerns.

STRESS

Stress has been attributed as the major cause of a variety of illnesses globally. By 2030, mental health disorders are expected to be the major contributors to people's illness (WHO, 2018). Stress is often defined as the generalized, non-specific response of the body to any factor that overwhelms or threatens to overwhelm the body (Sampasa-Kanyinga & Chaput, 2016). There is numerous research that clearly illustrates the strain stress can cause the mind and body (Sampasa-Kanyinga & Chaput 2016; Thomas &

Borrayo, 2016; Shneider, Schonfelder, Wolf, & Wessa, 2020; Beiter et al., 2015; Dumford & Miller, 2018).

Sampasa-Kanyinga and Chaput (2016) investigated the associations among self-perceived work and life stress, trouble sleeping, physical activity and body weight among Canadian adults. A total of 25,113 interviews were conducted with individuals between the age of 20 and 74 that have worked at a business in the last 12 months. The findings showed that self-perceived work and life stress and trouble sleeping were associated with excess weight. Therefore, it is apparent that stress received during work and stress in ones' personal life can have negative impacts on ones' health and wellbeing. This can come in the form of lack of sleep and lack of motivation towards physical activities, resulting in weight gain.

Thomas and Borrayo (2016) sought to understand how missed classes and work are linked to psychosocial factors in university students. The authors collected data from 303 undergraduate students enrolled in psychology courses through self-reporting questionnaires. They found that there was an increase in high perceived stress and absenteeism due to illness when students were not satisfied with their social support. Students who reported two or more instances of missed class and work had significantly higher perceived stress. Therefore, providing a more satisfactory support system is one of the first steps needed to insure students physical and mental wellbeing.

Dumford and Miller (2018) utilized data from the 2015 National Survey of Student Engagement (NSSE) to determine how taking courses through an online medium impact's student engagement as well as the stress of insufficient instructor interactions. Participants included in this data pool were first years and seniors usually in their fourth- or fifth year nearing graduation. There was a total of 300,543 participants across 541 U.S. institutions, of which 42.6% of the respondents were first years while the remaining 57.4% were seniors. In addition, the sample included students taking online classes only (7.2%) and those who were taking no classes online (76.1%). The results showed

that first-year students specifically who take more classes online reported lower levels of collaborative learning in their courses, fewer diverse discussions with others, and lower quality of interactions. On the other hand, they experienced enhanced engagement in quantitative reasoning. The senior students' ratings of effective teaching practices, student-faculty interaction, discussions with diverse others, quality of interactions, and collaborative learning were lower when they were taking more online courses. This shows that online learning is still lacking in certain areas of engagement for comprehensive learning.

Physical Illness

Stress is not only something that affects university student's mental health, but is also attributed to negatively impacting their physical health. "Stress is associated with physical illness among university students… feeling ill from stress-related ailments (e.g., flu, headache, cold, sore throat) are reported as the most frequent and justified reasons for undergraduate absenteeism" (Thomas & Borrayo, 2016, p. 247). As academics become a defining aspect of university students lives, stress and its physically debilitating outcome can influence the students' outlook on their academic career. While academics can be perceived as a positive challenge, potentially increasing learning capacity and competency, if viewed negatively, this stress can be detrimental to the student's health (Beiter et al., 2015).

Impact on Sleep

In parallel, having a good night's sleep has protective effects on stress (Sampasa-Kanyinga & Chaput, 2016). Having proper sleep patterns is important because stress is often associated as a reason for missing class (Thomas & Borrayo, 2016). With the decline in defining academic life and personal life due in part to the amount of time spent on academic work outside of class, factoring sleep can become a challenge. Online classes become a readily available source of stress for students making it

difficult to adapt to online courses (Dumford & Miller, 2018). Insufficient sleep has been identified as an important correlate of stress (Sampasa-Kanyinga & Chaput, 2016). Sleep deprivation can even be heightened amongst students in online courses impacting their academics, especially students with existing stress and poor sleep patterns. The needs and situations of students can greatly impact their educational experiences and institutions should take care not to exacerbate existing gaps (Dumford & Miller, 2018).

Physical Activity

The continual presence of stress in life can degrade student's mental health, physical health, and overall motivation (Thomas & Borrayo, 2016). Stress can become a roadblock for university students trying to assume a productive lifestyle. Stress may impair efforts on adopting or maintaining healthy physical activity levels even though regular physical activity is a well-known intervention for stress (Sampasa-Kanyinga & Chaput, 2016; Shohani, Badfar, Nasirkandy, Kaikhavani, Rahmati, Modmeli, Soleymani, & Azami, 2018).

Shohani et al., (2018) conducted a study to investigate the effects of yoga on stress, anxiety, and depression in Iranian women. The study contained a pretest and a posttest utilizing DASS-21 as the instrument. Yoga exercise (posture, breathing techniques, meditation) was held for four weeks meeting three times a week for 60-70 minutes, totaling 12 sessions. The authors concluded that depression, anxiety, and stress significantly decreased after the 12 sessions of yoga.

Schneider et al., (2020) conducted a study to determine if stress is perceived differently between clinical and nonclinical subjects. The authors utilized the Perceived Stress Scale (PSS) for the study. Data was collected via online surveys yielding 1,248 individuals between the age 18-65 for nonclinical subjects and 575 individuals between the age 19-64 for clinical subjects. The PSS is a 10-item questionnaire with a five-point

Likert type scale ranging from 1 (never) to 5 (very often). The final score of the PSS were determined by taking the answers from questions four, five seven and eight and reverse scoring them, then totaling all the items. Higher scores reflected greater levels of perceived stress. The authors concluded that varying stress levels of people with different mental health statuses are due to interindividual differences.

Beiter et al., (2015) investigated the potential correlation between depression, anxiety, and stress in a sample of 374 university students between the ages of 18 and 24. The survey Included demographic items, a stressor evaluation section, and the DASS 21. The stressor evaluation consisted of 19 stressors that were deemed relevant to university students. Answers were reported on a Likert scale (0-4) ranging from “not at all significant” to “extremely significant”. The DASS 21 was used to measure the levels of depression, anxiety, and stress. Based on the answers reported from the stressor evaluation, the authors determined that there were strong correlations between stress, depression, and anxiety. Therefore, individuals who are suffering from stress can become anxious and depressed. Of the 19 stressors listed in the survey, the 10 stressors that contained the most percentage of respondents were 1) academic performance (84.5%), 2) pressure to succeed (69.8%), 3) post-graduation plans (54.8%), 4) financial concerns (54%), 5) quality of sleep (36.9%), 6) relationship with friends (35.6%), 7) relationship with family (35.2%), 8) overall health (33.7%), 9) body image (32.4%), and 10) self-esteem (32.4%).

DEPRESSION

Depression is a scourge that strikes at university students’ vulnerability. According to the World Health Organization, depression affects around 300 million people and is now the leading cause of disability worldwide (WHO, 2017). Depression is characterized by persistent low mood, dysphoria, and impaired motivation (Kandola, Franks, Hendrikse, Sabiston, Stubbs, 2019). Research has shown how prevalent depression is in students’ lives and ways to help mitigate it (Scarapicchia, Sabiston, O'Loughlin, Brunet, & Chaiton, & O'Loughlin, 2014; Kandola, Franks, Hendrikse, Sabiston, & Stubbs, 2019).

Scarapicchia et al., (2014) looked to determine if symptoms of depression undermine motivation and participation in moderate-to-vigorous physical activity (MVPA)The authors surveyed 319 participants in Montreal that were already part of the Nicotine Dependence in Teens (NDIT) study when they were age 20 years and then again at age 24 years. The study concluded that depression symptoms may indeed undermine controlling motivation resulting in decreased MVPA. The authors iterated that intervention strategies are required to address depression symptoms to promote sustained MVPA.

Kandola et al., (2019) conducted a review which assessed key biological and psychosocial mechanisms where physical activity exerts antidepressant effects, with a specific focus on exercise. The authors focus on the capacity negative stimuli has on impacting neural plasticity playing a significant role in the onset and development of depression and how exercise can mitigate this. The authors concluded that there are positive influences between physical activity and suppressing depression. Therefore, it is important to block out time for breaks which allows for the opportunity to be dynamic, thus receiving the mental benefits from exercise.

ANXIETY

Anxiety is one of the leading mental health disorders in the world (Bettmann, Prince, Hardy, & Dwumah, 2018). Anxiety disorders are characterized by fears, avoidance of specific situations or activities, and negative feelings at times of heightened stress (Rapee, 2015). There has been research conducted making evident the detrimental effects anxiety has on one’s health, (Rapee, 2015; Bettmann, Prince, Hardy & Dwumah, 2018).

Rapee (2015), conducted a review on adolescent anxiety and some of the causes and outcomes. It was found that anxious children have fewer friends than other young people and the quality in their friendships are drastically lower in mutual support. Peer exclusion and victimization can play a particularly strong role in the development of

anxiety disorders later in life as well. It is concluded that anxious disorders in children are common and are widely under-recognized making anxious children the least likely to receive help from mental health professionals. Anxiety is part of the trio of mental health issues, the other two being stress and depression. Therefore, to prevent further issues from arising, actions need to be taken to treat anxiety with the same importance as the others.

Bettmann et al., (2018) investigated how anxiety and depression affect and are dealt with in Ghanaian and American university students. The authors utilized the Hopkins Symptom Checklist-25 which is a self-report Likert-type questionnaire that gauges general mental health symptomatology on a 4-point scale. Results showed that compared with their U.S. counterparts, Ghanaians reported lower levels of general distress, higher levels of anxiety-specific distress, and comparable levels of depression-specific distress. The finding that the general aspect of distress is lower in Ghana is consistent with previous findings that self-reported anxiety and depression are higher in the United States than in sub-Saharan African countries, including Ghana.

SUMMARY

It is apparent that stress, depression, and anxiety have a prevalent tole on the health of university students. Stress works its way into all aspects of their lives, which in turn impacts their academic life and physical health. With the weight of course work and no discerning factor between academic life and leisure, depression can set in and work against every effort to improve the state of the student’s wellbeing. Unlike depression and stress, anxiety is widely overlooked alienating the afflicted (Rapee, 2015). These three mental health issues are important to address early on in university life with mitigating techniques.

Meditation and Mindfulness

Meditation is the act of giving your attention to only one thing, either as a religious activity or as a way of becoming calm and relaxed. The first definition can be found in the Cambridge dictionary in the 13th century. Meditation practices are embedded in conceptual frameworks that describe states beyond ordinary waking experiences (Travis, 2014). Through meditation, we can alleviate stress that affects our body and mind. Deep rest to the mind can resolve patterns of stress in the mind (Hankey & Shetkar, 2016; Glueck&Stroebel,1975) and physical health (Iqbal, Singh & Aleem, 2016).

Travis (2014) conducted a review on transcendental experiences during meditation. The author defines transcendental meditation (TM) in which it is a practice that can be described as thinking or repeating a mantra or a sound without meaning and going back to it when it is forgotten. The author reviewed a study in which 52 university students who practiced TM for a few months to over 8 years were asked to describe their deepest experiences during TM practice. All of their reports were of a state where thinking, feeling, and individual intention were missing, but self-awareness remained. Therefore, TM can be a useful technique to remove oneself from ongoing stressors or problems and take the time to focus on the states of one's mental health.

Hankey and Shetkar (2016) conducted a review on how self-awareness is strengthened by meditation practices leading to the state of pure consciousness, also referred to as the content-free state of mind in deep meditation. In a case they reviewed, it was noted that there was considerable success in self-transcending during meditation. The study was conducted by Bernard Glueck, director of research at the Institute for Living in Hartford, CT, along with Charles Stroebel, director of the Institute's Psychophysiology Laboratory, in which they found that transcendental meditation (TM) improved the conditions of schizophrenia patients. Glueck and Stroebel (1975) surveyed 182 psychiatric centers in Sweden to determine whether meditation was contributing to

mental breakdowns. It was found that Sweden's 35,000 practitioners of TM exhibited far higher levels of mental health. They concluded that there were no connections between mental illness and meditation. From their reviews, Hankey and Shetkar conclude that deep meditation is extremely beneficial for mental health.

Iqbal, Singh and Aleem (2016) investigated the effects dynamic meditation has on mental health with 60 participants ranging in the age of 18-55. They divided the participants so that there were 30 in the control group and 30 in the experimental group. The study measured mental health with the Metal Health Inventory developed by Jagadish and Srivastava (1983). The inventory consisted of 56 items in six areas: positive self-evaluation, perception of reality, integration of personality, autonomy, group-oriented attitude, and environmental mastery mindfulness. The higher the score on the inventory indicates better mental health. The experimental group participated in a 21-day dynamic meditation training. Based on the comparison between the two groups, the authors conclude that dynamic meditation was effective in improving the mental health of the participants in the experimental group.

MINDFULNESS

Mindfulness is the practice of being aware of your body, mind, and feelings in the present moment, thought to create a feeling of calm (Cambridge dictionary, 1970). With increasing research and practice, mindfulness has brought upon a new perspective on health and wellness (Haro et al., 2017). Because the body and mind alike can be affected by stress and other disruptive feelings, it is important more than ever for university students to look after their wellbeing. Poor mindsets lead to poor choices, but practicing mindfulness has putative benefits for both mental and physical health (Ching, Koo, Tsai & Chen, 2015; Haro et al., 2017).

Ching et al. (2015) conducted a study to determine the effects a one semester long mindfulness course could have on students. The authors had first year university students ages 18-19 in South Taiwan broken into a batch of 152 for the experimental

group and 130 for the control group. The experimental group were required to submit a practice diary as well as watch online course material pertaining to mindfulness. The Chinese version of the College Learning Effectiveness Inventory (CLEI) and a set of computer cognitive tasks through E-prime were used to measure the effects of mindfulness intervention on students learning and cognition. The authors concluded that with just one semester of the mindfulness course, students showed significant improvement in learning performance.

Haro et al. (2017) conducted a pilot study to determine if a virtual designed space paired with virtual reality (VR) equipment can help facilitate mindfulness practice and reductions in negative emotional states. There were 44 participants in the day long pilot study ranging in age from 21-69. The authors used a VR headset to immerse the participants into the designed space which brought the participants floating down a river whilst listing to mindfulness technique instructions. The participants took a brief battery of measures before and after the virtual intervention. The survey consisted of the Visual Analog Scale (VAS), Mindful Attention Awareness Scale (MAAS), the sense of presence questionnaire, the Credibility/Expectancy rating, and the Independent Television Company SOP Inventory (ITC-SOPI). The authors concluded that after the VR intervention, participants reported feeling less sadness, anger, and anxiety, and reported feeling significantly more relaxed.

SUMMARY

Meditation and mindfulness are shown to improve the state of the mind and body (Travis, 2014; Hankey & Shetkar, 2016; Glueck &Stroebel,1975; Iqbal, Singh & Aleem, 2016; Ching et al., 2015; Haro et al., 2017). With the blurred lines of academic life and leisure for many university students, taking their own wellbeing into consideration can become overlooked. But in doing so, they open the possibility of further mental health and physical health issues. The reduction of stress through meditation and mindfulness practices can thus create a ripple effect of positive outcomes towards student’s mental health and physical health, such as feeling refreshed and more focused, reduced stress

related ailments, and having a steady balance between the mind and body (Travis, 2014; Iqbal, Singh & Aleem, 2016). Living and working with continuous levels of stress is detrimental and having the chance to relax the mind and body through meditation and mindfulness practices is paramount for student's well-being. Furthering the possibilities of accessible meditation and mindfulness practices is something that needs more attention. The benefits are known, getting students engaged and willing to practice is the next major step.

How Nature Affects our Well-Being

There are pathways between nature and health involving air quality, exposure to nature, social cohesion, and stress reduction that are linked to Biophilia (Hartig et al., 2014). As it is, air quality can play a deciding factor in how much exposure to nature we receive, because people cannot remain healthy without clean air (Hartig et al. 2014). With the implementation of green spaces in urban areas, attaining exposure to nature can become easier allowing for regular physical activity (PA) outdoors which positively affects health throughout one's life (Keskinen, Rantakokko, Suomi, Rantanen &Portegijs, 2018). The effects of being exposed to nature can be seen in Kaplan & Kaplan (1995) Attention Restoration Theory (ART), which suggests that mental fatigue and concentration can be improved by spending time in or looking at nature. This can be especially rewarding for university students that find it difficult staying focused on work.

BIOPHILIA

Biophilia, is the human tendency to interact or be closely associated with other forms of life in nature (Merriam Webster dictionary, 1979). Biophilic elements have been especially beneficial to residence of large urban areas because it provides the necessary exposure to nature that humans innately strive for (Stavrianos, 2016). This coincides with Kellert's (1993) biophilia hypothesis, that people need contact with the natural environment in the same way they need contact with other people, it is a

necessity for their development. Research has established the benefits biophilic elements have and ways to integrate them into everyday experiences, (Hartig et al., 2014; Keskinen et al., 2018; McGee & Marshall-Baker, 2015; Stravianos, 2016; Neill, Gerard & Arbuthnott, 2019).

Hartig et al. (2014) examined the concept of nature in the built environment and conducted a review of existing research. Nature in the article is defined as the physical features and processes of nonhuman origin that people ordinarily can perceive. The authors push the concept of nature into the man-made realm and address urban nature. Urban nature is the inclusion of indoor plants, street tress, urban parks and community gardens all found in the built environment. All these aid in the betterment of our health and wellbeing through air quality, especially in densely populated urban areas. In the reviews, they sought out many literature articles on nature and human health that have been published between 1946 and 2013. This was a systematic review on the field and the quality of its research. The authors found that the benefits of implementing urban nature is substantial.

Keskinen et al. (2018) studied the correspondence between the objective and perceived environment to assess their associations with physical activity. Their study was conducted using a 848-person community with ages ranging from 79-90. Participants were interviewed on their experiences walking outdoors with nature as a facilitator for outdoor PA. The presence of water and landscape diversity around the participants' homes were assessed and documented. Their findings revealed that higher habitat diversity and presence of water within natural areas correlates with higher levels of PA.

McGee and Marshall-Baker (2015) developed the Biophilic Design Matrix (BDM) to aid designers or other specialists in identifying and quantifying biophilic features. With mounting evidence to support the healing attributes of biophilic environments, the authors proposed a method to identify biophilic content within interior spaces. Because a vast majority of Americans are staying inside, the method used in this study derived

from Stephen Kellert's biophilic design attribute list which was modified to be appropriate for interior environments. As a result, there is an attempt to create a relationship with nature from the interiors for those that do not have the chance to go outside. The BDM revealed that biophilic attributes were consistently present in some spaces while others were completely absent. When a biophilic attribute was present, the BDM indicated that they varied considerably in type and occurrence.

Stavrianos (2016) reviewed the importance and the benefits Environmental learning (EE) or learning outside, giving students more exposure to the natural world can have. The author brings up the example of a school garden as an educational tool. It was stated that EE is a lifelong learning process that leads to the creation of informed and active citizens. It was found that during the last two decades there have been increasing interest in the use of school gardens due to its benefits towards stress and improved learning. The authors findings from the review therefore show the positive impact school gardens have on stress reduction and student learning.

Neill et al. (2019) examined whether the duration of nature contact influences the magnitude of benefits for both hedonic (positive and negative affect) and self-transcendent emotions such as awe, gratitude, wonder, and the sense that you are part of something greater than yourself. One hundred and twenty-three students ranging in age from 17-45 years from the University of Regina Psychology Department participated. The researchers assessed whether mood benefits could be observed with five minutes of nature contact in the absence of exercise using the Positive and Negative Affect Schedule (PANAS) and Elevating Experience Scale (EES). These surveys were administered before and after the nature exposure as a pre- and post-test. They determined that five minutes of contact with nature was enough to substantially influence negative effects of stress.

Neill et al. (2019) then tested to determine if longer duration of nature contact increases the mood benefit using 70 participants. Participants were exposed to nature in randomly

assigned increments of either 5 minutes or 15 minutes. The PANAS, EES and DASS-21 were administered before and after the nature exposure as a pre- and post-test. The results found from the second study showed that the increase in contact time in nature did not influence mood benefits. Therefore, exposure to nature plays a role in wellbeing and positive influence on mental health.

BIOPHILIC DESIGN

There are biophilic design strategies, called patterns, that can be implemented into the built environment to reflect the natural world. This includes prospect, refuge, mystery, risk/peril as well as light and space. Biophilic design can reduce stress, enhance creativity and clarity of thought, improve our well-being, and expedite healing (Browning, Ryan, & Clancy, 2014). In tandem with the patterns of biophilic design, Ulrich's (1992) Stress Reduction Theory (SRT) suggests that there is an emotional and psychological reaction to being in natural spaces. Residing in an unthreatening environment or viewing natural elements promotes a sense of relaxation and reduced stress (Ulrich & Parsons, 1992). With the SRT in mind, the built environment can be designed where it promotes the benefits provided by nature through the patterns of biophilic design.

Prospect

Prospect is described as emphasizing discerning distant objects, habitats, and horizons, evolutionarily instrumental in locating resources, facilitating movement, and identifying sources of danger (Kellert, Heerwagen, & Mador, 2008). This can create a feeling of control and safety, as well as reductions in stress, boredom, irritation, fatigue and perceived vulnerability, and improved comfort (Browning et al. 2014). An example of prospect in nature could be a hillside overlooking a valley. This can be a good facilitator for meditation either in the built environment or out in nature.

Refuge

Refuge is a place for withdrawal, from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead (Browning et al. 2014). Refuge is sought when people are ill, tired, or want privacy to withdraw and replenish their psychological and physical resources (Kellert et al., 2008). In large parks or in nature in general, refuge places can be found under trees or vegetation bordering an open field or meadow (Browning et al. 2014).

Mystery

Mystery is the promise that more information could be gained by moving deeper into a setting (Kellert et al., 2008). This pattern comes from the idea that people have two basic needs in the environment: to explore and to understand (Kaplan & Kaplan, 1989). The complementary contrast of light and dark spaces can produce the pattern of mystery enticing the user to explore further into a space or be intrigued by a different path. This can be experienced in the built environment and nature (Kellert et al., 2008).

Risk/Peril

Risk/Peril is identified as settings of real dangers that are fully evident, but they are dangers we can control (Kellert et al., 2008). This pattern presents apparent and dramatic danger, but in all cases, it is a controlled degree of risk which is found to be thrilling…this pattern can be experienced through purely natural settings such as Niagara Falls and the Grand Canyon (Kellert et al., 2008). The thrill of looking down the Grand Canyon provides a sense of peril because of the sheer drop, but fits into the prospective pattern by being a controlled risk/peril experience.

Light and Space

Light and space have a relationship in which when working in tandem can promote unique attributes. Biophilic patterns represented by light are diffused light, reflected light, and pools of light. The benefits of natural light are often enhanced by modulating daylight through diffused sunlight, which can stimulate observation and feelings of connection by providing a relationship between spaces, particularly inside and outside (Kellert et al., 2008). This pattern can be found in nature caused by clouds coasting in front of the sun reducing the intensity of sunlight. Reflected light can enhance natural light by reflecting off surfaces such as light-colored walls, ceilings, and reflective surfaces like water. Reflected light can draw more natural light deeper in a space or natural environment (Kellert et al., 2008). Light pools can provide a sense of wayfinding. Light pools provide lighted patches across shadowed or obscured areas such as a forest or darkened halls and passageways (Kellert et al., 2008).

SUMMARY

It is evident that university students are experiencing depression, anxiety, and stress now more than in recent years and that these can have dire effects on physical and mental health. Exposure to nature has been shown to lessen the effects of stress on the body and mental health. However, there are factors that encroach on the student's opportunity to experience the health benefits. Therefore, more research on readily accessible exposure to nature for students is needed.

CHAPTER III: METHODOLOGY

This chapter investigates the elements that brought this exploratory study together to determine if virtual reality can be a viable conduit for active meditation for stress relief in university students. The initial section will address the participants as a convenience sample, how they were recruited, what they did during the study, as well as the location. The next section will discuss the instruments used as well as a description of reasoning for and the process of designing the virtual meditation space. The final section will address the data collection procedures including the pilot study.

There is a clear understanding that exposure to nature is beneficial to our wellbeing. The state of our mental health can keep some from actively seeking nature bringing up the option of bringing nature to them. Therefore, the following research questions will be answered in this study.

1. How can a virtual meditation experience impact university students' depression?
2. How can a virtual meditation experience impact university students' anxiety?
3. How can a virtual meditation experience impact university students' stress?
4. Can different biomes in the meditation experience promote more effective stress relief?
5. Does lighting effects influence participants' decisions on biome choice?

Site and Participants

The research was conducted in the library of the Gatewood studio arts building on the UNC Greensboro's campus. The test location was spacious enough for the VR equipment and allowed participants and the researcher to maintain social distancing. The room was completely enclosed and had little natural light making it ideal for controlling the lighting and sound levels. It was important to utilize a space that was

near the participants studio whilst still being closed off from the rest of the studio space because it would allow for minimal distractions, as well as keeping them in a familiar area that would end up being a short walk back to their desk.

Students from the department of Interior Architecture were chosen because of the amount of course work and time required to be successful for the degree. This places considerable stress levels on the students in this demanding degree making them ideal participants to test virtual meditation intervention. Undergraduate students in their second, third, and fourth year, as well as graduate students were targeted for recruitment because these groups typically have heavier loads of work and expectations, therefore generally experience more stress in the program. The students from this department were also more accessible for the study making them the ideal candidates.

Thirty-seven participants were recruited from three courses. Six of the initial 37 participants were omitted from the study due to their time lapse between their first and second session being 14 or more days, therefore, 31 participants were used in the data analysis as shown in (Table 1) which breaks down the participants demographics.

Table 1. Participant Breakdown

	Frequency (N)	Percentage (%)
Gender		
Male	6	19.4
Female	25	80.6
Academic Level		
2nd year	17	54.8
3rd year	6	19.4
4th year	5	16.1
Graduate	3	9.6
Age range		

18-21	20	64.5
22-26	8	25.8
32-36	2	6.4
37+	1	3.2
Gaming experience		
Never	10	32.2
Once a month	10	32.2
Once a Week	2	6.4
Every other day	5	16.1
1 hour day	2	6.4
2 or more hours a day	2	6.4
Exposure to nature		
Never	2	6.4
Once a month	4	12.9
Once a Week	10	32.2
Every other day	9	29
1 hour day	3	9.6
2 or more hours a day	3	9.6

Recruitment

Recruitment took place during the student's studio class at a time agreed upon with the course's instructors. Each course was given the same introductory statement, explaining the study's objectives, requirements for participation, information about virtual reality and how it is integrated into the study, and when the meditation session would take place. Students were told that they would have a total of thirty minutes each session. After briefing each course with this information, a signup sheet was passed around for students to fill in their name and email, which would later be used to create a schedule for contacting the students to set up a time to participate in the study.

Instrument

The instrument consisted of a printed questionnaire divided into three sections, totaling 36 items, see appendix A. The first section consisted of five demographic questions, such as their identified gender, level in the program, age, and the amount of time they spend in nature and playing video games. The next section included 10 Likert type questions from the Perceived Stress Scale (PSS) developed by Cohen, Kamarck and Mermelstein (1983). Each question asked participants to rate the degree to which situations in their life are perceived as stressful from 0-4 with 0 being never and 4 being very often. The last section included 21 Likert type items from the Depression Anxiety Stress Scale by Lovibond and Lovibond (1995). Each question asked participants to rate how much each statement applies to them within the last week from 0-3 with 0 meaning does not apply to me at all and 3 meaning applies to me very much, or most of the time. Both the PSS and DASS were modified with the addition of “recently” at the start of each question to make them more relevant to the participants current life events. Participants were administered a pre- and post-test survey during their time in the study. The pretest was given on the first session at the beginning before they went into the virtual meditation environment, and the post test was given during the second session after participants finished exploring the virtual meditation environment. Both the pre and posttest contained the PSS and DASS, the only difference was that the posttest did not include the five-demographic question contained within the pretest.

THE VIRTUAL ENVIRONMENT

The virtual meditation space was developed utilizing an open-source game engine called Unreal Engine 4 (UE4). UE4 was chosen because it was free and there is an extensive community and marketplace connected to it which provided access to assets (items that can be placed in the virtual environment) that could be bought and used in the designing process. The first challenge to overcome was designing a controlled environment that allowed for exploration and was visually engaging with unique features. The shape of the environment was modeled as an island surrounded by a

body of water which in turn was enclosed by a barrier of rocks. This was done to implement a series of non-evasive barriers so participants would not wander to the edge of the map. If by chance participants did go to the edge of the map, there was an invisible barrier encircling the entire map that would prevent them from going any further. The island was designed to contain six biomes; a cave, mountain, forest, hot spring, beach, and ocean to provide diversity for the size of the island while incorporating various biophilic attributes. Biomes were then given general locations on the island and connected with a series of paths creating one seamless transition from biome to biome. Each biome was designed by implementing the patterns of biophilic design, which included prospect, refuge, mystery, risk/peril as well as light and space. Animals were also integrated into the island to make it feel lived in, and to add interest to the experience. Audio mapping through the inclusion of birds chirping, gusts of wind, and the light crashing of waves, was added to give the island a more real experience and to immerse the participants. The design time for the environment from start to finish was approximately five months.

Cave

The visually damp and dark space was designed with the patterns refuge and mystery. The cave was designed to incapsulate the participants upon entering. This idea came from the pattern of refuge which is to provide cover in all directions creating a sense of security. The cave was created to show minimal information to the participants keeping them guessing and interested in finding out more. This was adopted from the pattern of mystery.

Figure 1. Cave Entrance with Wayfinding, Security and Comfort

In Figure 1-3, there is limited information provided, but just enough for participants to know that there is more if they keep exploring. Because there needed to be a stark difference in lighting from being outside to entering the cave, additional lighting elements were added to provide not only visibility, but wayfinding as well. Light particles were added inside the cave to mimic fireflies moving around and glowing mushrooms provided just enough diffused ambient light to make out a pathway while keeping the dark atmosphere, enhancing the mystery as shown in Figure 1. Torches were added as a dynamic effect creating flickering light as well as reflecting the light in the cave to create a point of interest. They also were used to entice the participants to explore a new trail as shown in Figure 2 and Figure 3.

Figure 2. Pathway to the Mountain from the Cave

Figure 3. Entrance to the Mountain

Forest

The forest covered most of the island and needed to be designed so participants were visually intrigued while traveling through it to other biomes. Figure 4 shows how the pattern of risk/peril was incorporated in the design of this part of the biome. The plain leads to a ledge that spells imminent danger, but danger that is easily controlled by the participant. It creates an exhilarating sensation which is what the referenced pattern encompasses (Browning et al, 2014). There is also a transition of light and shadow. The trees block the sun's rays heavily diffusing the light creating a dark cool space while only a few steps away, the sun light is almost blanketing the rest of the area. Figure 5 better details the space near the open plain. This area was designed similarly to a crater with rock formations surrounding it from all sides and covered overhead by the tree canopy. This space was designed using the patterns of refuge, and mystery as well as utilizing light and shadow. This was specifically chosen to be the start location for the virtual meditation experience because it was the most centralized location on the island. Dynamic elements were added such as the waterfall as seen in Figure 5 and the fireflies.

The starting location was designed heavily with refuge in mind. This was the first contact point for participants and feeling protected with limited visual information would be best so that they wouldn't be visually overwhelmed. It was essential to incorporate mystery to this area so participants would not stay in this location, but rather be interested in exploring the island. This was achieved by incorporating insinuated paths leading out of the start location. Mystery can also be seen in Figure 6 which shows a glimpse of a new biome that can be explored by moving deeper through the forest and out from the brush. Diffused light and transitions between light and shadow were incorporated throughout the forest biome and Figure 7 shows an example of such. This biome was designed to have pockets through the tree canopy to let in pillars of light as well as clumping more trees to create diffused light with the branches.

Figure 4. Light and Shadow, Clarity, and Obscurity

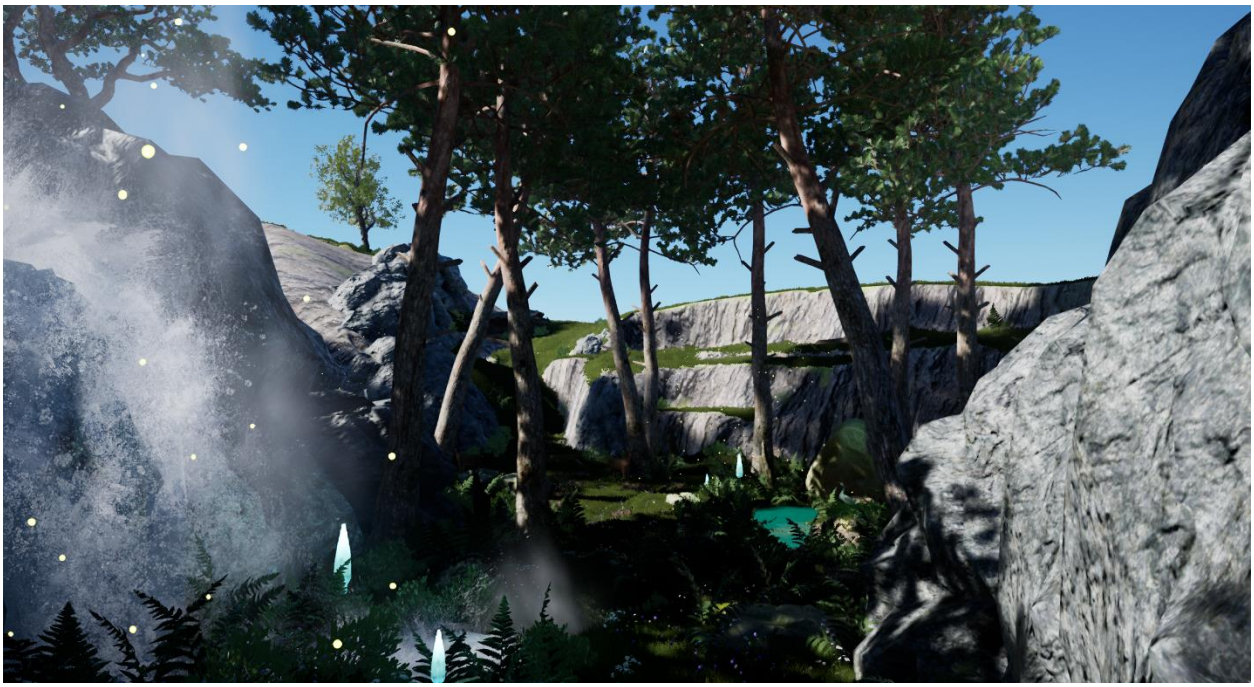

Figure 5. Rushing Water and Fireflies

Figure 6. A Glimpse of the Beach

Figure 7. Sunlight Through the Canopy

Ocean

The ocean biome focused on an aquatic experience for participants. The ocean was designed with layers of underwater life and multiple opportunities to implement mystery. The dynamic water also added reflections of light on the sea floor that can be seen in Figure 8. This biome incorporated the pattern of mystery through subtle hints of further detail such as the stairs that lead out of the water. There is a clear insinuation that there is more up the stairs, and this is used to draw participants into further exploration of each biome. The underwater life such as the fish added an element of visual engagement and something to interact with for a more immersive experience. The fish had a barrier around them called a collision, which gave them a sense of being a solid object and could be touched while in the virtual environment.

Figure 8. Shimmering Underwater Life

Beach

The secluded beach was designed around the biophilic patterns of risk/peril, mystery, refuge, and prospect. Figure 9 shows an arch way made by large rocks resting on each other. This was designed to split the biome into a north and south beach, but also to encourage participants to experience the sense of danger as they traversed underneath. The top of the arch was designed as a prospect, providing an unobstructed view out into the ocean. This was also an area where participants could reflect on their journey as they basked in the view in front of them. Figure 10 shows how mystery was added into the beach design. It shows the tree line in the front and the water line of the ocean as well as the archway to the south side of the beach. Those three areas were obscured but provide enough information to suggest there is more beyond it if participants ventured further. This was done to keep the participants engaged in their surroundings and interested in exploring. Figure 11 displays how refuge was referenced in designing this part of the beach. The space is a small island attached by a sand bar to the main island. It is covered in foliage and was designed to be a safe and comforting space. The balance between light and shadow added a closed off feel to it, but with its open view of the beach, it is still connected.

Figure 9. A Perilous Overlook

Figure 10. Open Views

Figure 11. Discrete Field of View

Hot Spring

The hot spring was tucked away in the northern most section of the island. Participants were able to access it through a cave exit and by traveling through the forest biome. This space was influenced from the biophilic design pattern of mystery. As shown in Figure 12, the difference in elevation and steam makes it so the rest of the space is obscured. This was to draw participants in and then reward them with a secluded virtual hot spring. Trees were also placed around the entrance of the hot spring to emphasize the play on light and shadow. The shadows around the entrance allowed for the light to put emphasis on the actual hot spring, in turn creating a point of interest.

Figure 12. Light on the Other Side

Mountain

The mountain was a towering landmark designed using the biophilic patterns of risk/peril, prospect, refuge, and mystery that are shown in Figure 13. The peak of the mountain provides an unobstructed view of the entire island. It was designed for participants to be able to view the island and look back on where they explored and traveled to get to this point. The pagoda at the top of the mountain was created as a refuge and a space of reflection. The mountain biome encompasses risk/peril because of the sheer drop and height. Looking over the edge puts into perspective the size of the biome, as well as the size of the entire island. The mountain biome and pagoda are also visible from almost every point on the island. This was done purposefully to create mystery and intrigue behind the biome. The pathways to this biome were partially obscured, making participants that saw the mountain peak from a distance have to

explore to find a way to the top. This was added to the design to promote a sense of accomplishment for the participants once they found their way to the pagoda.

Figure 13. On the Summit

PILOT STUDY

Both the survey and the virtual meditation experience were piloted prior to submitting for approval from UNCG's Institutional Review Board (IRB). The survey was piloted with four graduate students to determine validity of the PSS and DASS questions wording. The original PSS questions stated, "in the last week." Based on feedback from the pilot study, "recently" was added in front of every question in the PSS and DASS to reinforce the connection to participants recent life events. It took an average of four minutes for the participants to complete the survey. The pilot participants met twice in which during the first session, they filled out the survey and went through the finalized virtual meditation environment. The second session involved the same procedure except the

survey was administered after they completed their walkthrough of the virtual meditation environment. The alteration of the PSS and DASS survey items allowed for the questions to better relate to the four participants experiences during the time between the pretest and posttest.

The virtual meditation space was piloted with 12 participants during its developmental stage to produce a better experience for the final study. Participants were asked to explore the virtual environment through a desktop virtual reality (without the VR equipment or goggles) method. Participants utilized standard computer game controls on the laptop to navigate the environment; being the w,a,s,d for movement and space key to jump. After exploring the virtual environment, participants were asked to fill out a survey consisting of feedback questions, refer to appendix B. The questions were used to assess the visual engagement and overall experience of the virtual meditation environment, and to gain feedback on elements that could make for a better experience. Based on feedback from the pilot study, the following features were added, interactive animals that moved through the biomes, the ability to move around in the ocean and clearly see the underwater life, as well as ambient sounds of nature which included wind blowing, birds chirping and the light sound of waves crashing.

PROCEDURE

Data was collected through the physical survey administered as a pre- and post-test. The 30 minutes participants dedicated to the study were broken down to ten minutes to complete their survey as well as a virtual tour of the meditation experience space, ten minutes to be debriefed on the VR controls as well as safety instructions if vertigo was experienced while in the space, and the last ten minutes went to the student interacting with the meditation experience.

Participants were taken from their class during their designated timeslot. Upon entering the test location, participants were asked to sign in and were given two codes, one ending in “A” for the pre-test and the other in “B” for the and posttest, to ensure

confidentiality. Participants would sign in with the code ending in “A” for their first session and would sign in with the code ending in “B” for their last session. Once signed in, the pretest survey was administered which was completed in less than five minutes. After the survey was collected by the researcher, a virtual tour of the virtual meditation environment was given, showing all the six biomes and how to get to them. This tour took no longer than five minutes. Participants were then provided with a five-minute briefing of the VR controls and tips to effectively navigate the space with the virtual character without physically moving. Participants were advised to plant their feet and face one direction, although they could rotate their head to look around as well as rotate their upper body from their waist up while keeping the feet planted. A safety briefing was then given advising participants to inform the researcher if at any time they experience dizziness or nausea, in which the VR equipment would be removed, and the participant allowed to gain their bearings. After the student understood the controls, and the safety briefing, participants then had ten minutes to freely explore the virtual meditation environment. Upon finishing the first session, participants would then return for the second session on their designated day. The researcher went through the same procedure as before except administering the posttest survey after participants completed their virtual meditation experience. The time between the pre- and post-test varied for some participants as shown in (Table 2) due to the course schedule, quarantine protocols, and the shifting of in person meeting times. For instance, one of the courses had sections that would meet in-person on Monday and Wednesday and would alternate between meeting in person or online on Friday. This resulted in participants having a two-day time laps and one student with a four-day time laps.

There were three courses from which participants were recruited from. The meeting days and times varied for the courses. For courses that met twice in a week, the pre-test for the first meditation session and post-test were administered two days apart. For courses that met once a week, the pre-test and post-test were administered between seven and 21 days apart. Given the inability for certain participants to meet during a set time and day, there was a lack of consistency from when the first and second sessions

was completed. This occurred due to absenteeism. This meant that some participants waited longer between sessions than others leaving more room for a stressor to happen while other participants had either one or three days in between sessions during the same week reducing the likelihood of a stressor to occur.

Table 2. Number of Participants and Time Lapse Between Pre- and Post-test

Time lapse	7-day	2-day	4-day	14-day	21-day
Participants	25	5	1	5	1

In order to determine the length of time the participants spent in the biomes; a recording of the participants view was captured. On average, participants spent 9.6 minutes actively meditating during the first session. The same 31 participants completed the post-test during the last meditation session. An average of 6.5 days occurred between the first and last mediation session. The participant's view was again recorded for data analysis. On average, participants spent 9.2 minutes actively meditating during the second session.

CHAPTER IV: FINDINGS

This chapter details the findings of the research study. Each research question is divided into a section where it iterates the statistical process and reports the results. The first three sections address the relationship between the independent variable, being the virtual meditation experience and the three dependent variables of depression, anxiety, and stress. The last two sections address the remaining research questions. Section four looks at the dependent variable of effective stress relief and its relationship to the independent variable of different biomes. The last section iterates the relationship between the dependent variable of biome choice to the independent variable of lighting effects influence.

1. How can a virtual meditation experience impact university students' depression?
2. How can a virtual meditation experience impact university students' anxiety?
3. How can a virtual meditation experience impact university students' stress?
4. Can different biomes in the meditation experience promote more effective stress relief?
5. Can lighting effects influence participants' decisions on biome choice?

The collected data was transferred from the instrument to excel for cleaning where the categorical variables were assigned numeric variables and was then analyzed in SPSS.

Similarly, in the second and third sections of the survey that contained the PSS and the DASS, the scores were calculated and input into excel. To find the participants' PSS score, answers to questions 4,5,7 and 8 where to be reversed, meaning if question 4 was answered with a 0, it would be switched to a 4, 1=3, 2=2, 3=1, 4=0 (Table 3). All the numbers were totaled. The score is out of 40 and the higher the score the more perceived stress. For the DASS, questions 1,6,8,11,12,14,18 were under stress, 2, 4, 7, 9, 15 ,19, 20 were under anxiety, and 3, 5, 10, 13, 16, 17, 21 were under depression. To

find the score, the answers that fell under each category were totaled, and a chart was referenced to determine where the participants depression, anxiety, and stress score landed (Table 4). The higher the score the more perceived depression, anxiety, and stress.

Table 3. PSS Scoring Scale

Original value	Reversed value for scoring
0	4
1	3
2	2
3	1
4	0

Table 4. DASS Scoring Scale

	Depression	Anxiety	Stress
Normal	0-4	0-3	0-7
Mild	5-6	4-5	8-9
Moderate	7-10	6-7	10-12
Severe	11-13	8-9	13-16
Extremely Severe	14+	10+	17+

Research Question 1

To ascertain the relationships between the variables, the results from the depression portion of the DASS were analyzed in a paired t-Test using SPSS. To determine if the relationships between the dependent variable depression and independent variable the virtual meditation experience had any statistical significance, a p-value lower than .05 ($p < .05$) was needed. The results determine that there is statistical significance (table 5). In this study, the meditation experience positively impacted participants perceived

depression. This means that after two meditation sessions participants had lower perceived depression levels.

Table 5. Paired t-Test for Depression

Variable	Value	Significance
All Participants	2.97	.006*

*Note. * p<.05*

Research Question 2

To ascertain the relationships between the variables, the results from the anxiety portion of the DASS were analyzed in a paired t-Test using SPSS. To determine if the relationships between the dependent variable anxiety and the independent variable, virtual meditation experience had any statistical significance, a p-value lower than .05 ($p < .05$) was needed. The results determine that there is statistical significance (table 6). In this study the meditation experience positively impacted participants perceived anxiety levels. Therefore, after two meditation sessions participants had lower perceived anxiety levels.

Table 6. Paired t-Test for Anxiety

Variable	Value	Significance
All Participants	3.88	.001**

*Note. **p<.001*

Research Question 3

To ascertain the relationships between the variables, the results from the stress portion of the DASS and the scores from the PSS were analyzed in a paired t-Test using SPSS. To determine if the relationships between the dependent variable, stress and the independent variable, virtual meditation experience had any statistical significance, a p-

value lower than .05 ($p < .05$) was needed. The results as shown in table 7 determine that there is statistical significance. In this study the meditation experience positively impacted participants perceived stress levels. Therefore, after two meditation sessions participants had lower perceived stress levels.

Table 7. Paired t-Test for Stress

Variable	Value	Significance
All Participants		
DASS	2.41	.023*
PSS	5.73	.000**

*Note. * p<.05; **p<.001*

SUMMARY

Results from the t-Test showed statistical significance for the variables. This means that the virtual meditation experience had a positive effect on university students' perceived depression, stress, and anxiety levels.

Research Question 4

To answer research question four, the PSS and the stress portion of the DASS was analyzed to determine if the biome type had an effect on perceived stress levels. To ascertain the relationships between the dependent variable of stress and the independent variable of biome type, a paired t-Test was used. Participants spent more time in the forest biome in both virtual meditation sessions than the other biomes, see table 8. The hot spring and ocean biomes were visited the least, see table 9. There were too few participants that visited the hot spring and ocean biomes to conduct inferential statistics, therefore those biomes were not analyzed. As shown in table 10, the beach and forest biomes had the most significant impact on perceived stress levels.

Table 8. Total Amount of Time in Minutes per Biome

	Beach	Cave	Forest	Hot spring	Mountain	Ocean
pretest	62.53	40.68	174.74	13.89	37.53	22.92
posttest	79.14	47.82	152.25	6.95	24.21	28.37
Total	141.67	88.5	326.99	20.84	61.74	51.29

Table 9. Number of Participants in each Biome

	Beach	Cave	Forest	Hot spring	Mountain	Ocean
pretest	N=19 (61.3%)	N=19 (61.3%)	N=31 (100%)	N=7 (22.6%)	N=11 (35.4%)	N=7 (22.6%)
posttest	N=22 (71%)	N=17 (54.8%)	N=31 (100%)	N=7 (22.6%)	N=12 (38.7%)	N=6 (19.4%)

Table 10. DASS and PSS Paired t-Test for Stress of Participants for Four Biomes

	Beach	Cave	Forest	Mountain
DASS	.031*	.642	.023*	.403
PSS	.000**	.007*	.000**	.006*

*Note. * p<.05; **p<.001*

Research Question 5

Descriptive statistics were used to determine if lighting effects influenced participants biome choice. Participants spent the most time in the forest, followed by the beach, cave, mountain and the least time in the hot spring followed by the ocean. The lighting effects found in the biomes included reflected light, pools of light and diffused light (table 11). The forest and hot spring biomes contained all three lighting effects; therefore,

lighting effects did not influence participants biome choice because the forest biome had the most overall time and visits, and the hot springs had the least whilst still having the same lighting effects present.

Table 11. Lighting Effects per Biome

	Beach	Cave	Forest	Hot spring	Mountain	Ocean
Reflected	x	x	x	x		x
Pools			x	x	x	x
Diffused		x	x	x		

CHAPTER V: DISCUSSION AND CONCLUSION

The initial section of this chapter will discuss the findings of the study and its impact towards depression, anxiety, stress as well as biomes that had the most impact. The findings will then be compared to studies conducted by Shohani (2018) and Haro et al. (2017). The next section will address the limitations that arose during the study and what was done to try and overcome them. The last section will discuss opportunities for future research.

The main objective of designing the virtual meditation experience was to provide university students with an accessible alternative to nature exposure. The virtual spaces aim was to bring nature to students while allowing them to experience dynamic meditation with the objective of reducing depression, anxiety, and stress. The study showed that the virtual meditation experience can positively impact university students 'perceived depression, anxiety, and stress. Furthermore, specific biomes can also play a factor in better stress relief than others.

Depression, Anxiety, Stress

Analysis on depression, anxiety, and stress scores revealed that they were positively impacted by the study with depression ($p < .05$), anxiety ($p < .05$), and stress ($p < .001$). This shows that the study was successful in its intention of providing students with an accessible means of positively impacting depression, anxiety, and stress. In agreeance with Haro et al. (2017) and Shohani et al. (2018), mindfulness and meditation practices can positively impact university students perceived depression, anxiety, and stress. Haro et al. (2017), conducted a study with 44 participants ranging in age of 21-69. The study lasted 25 minutes where 15 was dedicated to orienting the participants and briefing them on the pre- and post-test and 10 minutes allocated for participants to experience the VR space. Participants had their session on one of three days where

they would fill out the survey before and right after the experience. Results of the analysis showed depression with a ($p < .01$), anxiety ($p < .01$), and stress ($p < .01$) meaning there was significant positive impact on the participants perceived depression, anxiety, and stress. While Haro et al. had participants with a wider age range than this study, the mediation length was the same but the type of VR implementation was different. Haro et al. utilized a desktop VR approach which had the participant sitting in a chair with the VR headset on. In the authors case, participants did not have analog control in the space, rather participants were in a virtual ride. While this study allowed participants to take control of where they wanted to go in the approximately 100-acre virtual island containing six biomes. The amount of time participants went through the session differed in only being once, and the survey was administered before and after the session. This study had participants complete two sessions with days between the first and last session varying between seven, two, and four days. The surveys were also administered similarly to Haro et al. in terms of being a pretest and posttest, but this study had the pretest administered at the beginning of the first session and at the end of the last session.

Shohani et al. (2018), conducted a study to investigate the effects of dynamic meditation through yoga on stress, anxiety, and depression in 52 Iranian women with a mean age of 33.5. The sessions were held for four weeks meeting three times a week for 60-70 minutes for a total of 12 sessions. The pretest questionnaire was administered at the start of the 12 sessions and the posttest was administered at the end of the 12^{th} session. Results of their analysis show depression with a ($p < .001$), anxiety ($p < .0001$), and stress ($p < .0001$) meaning there was significant positive impact on the participants perceived depression, anxiety, and stress. Shohani et al. had more participants, and they were all female, while this study had a mixture of male and female that made up the 31 participants. The authors participants mean age was 33.5 while only three participants from this study where near that age. The biggest difference was the amount of time each session was, and the number of times met. The authors held sessions three times a week for four weeks totaling in 12 sessions which lasted 60-70 minutes

each. They did not use any VR equipment; their study was physical dynamic meditation through yoga. This study contained two sessions that allotted for 10 minutes in the virtual meditation experience. The pretest and posttest were administered at similar times being at the beginning of the first session and again at the end of the last session as the same with this study.

Biomes

The overall island was designed to be approximately 100 acres of explorable space consisting of six biomes. The forest biome was the largest covering most of the island and connecting all the other biomes together. This meant that to reach other biomes, participants had to always pass through the forest along the way. The starting point for the virtual meditation experience was also in the forest biome. Participants started in the most centralized point of the island so that no matter which direction they decided to walk, they would eventually find a new biome to explore. From the starting point, the cave biome and mountain biome were the closest with the hot spring being on the left sector and the beach being on the right. The sun was positioned over the beach biome so that participants could follow the light pools and rays piercing the forest canopy directly to the beach. There was anecdotal evidence of participants enjoying the beach biome more because it was the brightest, visually engaging because of the lightly crashing waves, and some stated they could almost feel the heat of the sun. participants wandered and explored the beach biome almost to its complete extent and were nearly always shocked that their 10 minutes ended so fast while traversing through the beach. The hot spring and cave biomes were more difficult to find which made them easier to miss, and the mountain biome (despite having three possible entrances) was also widely missed because of the obscurity of the entrances. It would take more exploration on the participants part to find these three biomes.

Research Limitations

This study had to cope with several limitations. The biggest being that it was conducted during the covid-19 pandemic. There were certain difficulties such as making sure that participants and the researcher were safe and practicing proper social distancing, therefore all equipment from the VR headset, controls, to pens used to fill out surveys were all disinfected before and after each use from participants. Because the headset covered participants eyes and would be in contact with their forehead and nose, disposable eye mask covers were handed to every participant to help reduce skin contact with the equipment. Making sure not to contract the virus or be a cause in spreading it was of the utmost importance. Organizing consistent session times was also a hurdle to overcome because in some cases, students did not show up to their session and working around each of the classes set meeting times was difficult.

All 31 participants did not have the same time lapse between the pretest and posttest meaning that outside factors could have influenced some participants over others during the study. Because it was not possible to have all participants meet on the same day, sessions were organized in such a manner as to allow for grouping of participants that could meet on days with a seven-day time lapse, four-day time lapse and a 2-day time lapse. This would at least allow for consistency within these groups.

The sample size of 31 participants poses the threat of questioning the reliability of the findings significance by making limited occurrences seem more common than they actually are. This means that the results become condensed and may seem bias due to the sample size. Looking at results from a small sample cannot be projected to a larger population. Even though participants from the study showed a decrease in depression, anxiety, and stress levels, if the sample was larger, there may have been more variation between decrease, no change, or increase in levels.

Future Research

For future research, it would be ideal to have set meeting days which would allow for participants to complete the pretest and posttest within a week. This would allow for ample consistency and lessen the possibility for some participants to experience outside influences over others. For the designed space, implementing a map would be beneficial for participants so that they can always know where they are and have more confidence in exploring further since they would be able to tell which biomes they are entering or are nearby. Increasing the sample size of the study would be beneficial in preventing bias in the results providing more accuracy. Also, since it was found that the three lighting effects used did not influence biome choice, adding more and diverse lighting effects to each biome could lead to different results than the ones found in this study.

Conclusion

The findings from this study corroborated previously conducted research on how meditation can positively impact one's mental health (Shohani et al., 2018; and Haro et al.,2017). This study showed that an immersed and engaged form of virtual meditation can have positive effects of students' perceived depression, anxiety, and stress levels, which is important because depression, anxiety, and stress are components of mental health affecting university students at alarming rates (ACHA, 2018). It has been found that 91% of university students report moderate to severe stress (American College Health Association [ACHA], 2018). More attention needs to be turned to mental health of university students, and accessible interventions need to be invested in.

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APPENDIX A: QUESTIONAIRE

Code:

Please read the questions and check the box of the statement that *most* applies to you. There are no right or wrong answers.

1. How often do you play video games?
(e.g, PC, Console or Mobile)
- ☐ Never
- ☐ Once a month
- ☐ Once a week
- ☐ Every other day
- ☐ 1 hour a day
- ☐ 2 or more hours a day

2. What is your gender?
- ☐ Female
- ☐ Male
- ☐ Non-binary

3. What is your year level in the program?
- ☐ 1st year
- ☐ 2nd year
- ☐ 3rd year
- ☐ 4th year

4. What is your age?
- ☐ 18-21
- ☐ 22-26
- ☐ 27-31
- ☐ 32-36
- ☐ 37+

5. How often do you spend time in nature? (e.g, walking on a park trail)
- ☐ Never
- ☐ Once a month
- ☐ Once a week
- ☐ Every other day
- ☐ 1 hour a day
- ☐ 2 or more hours a day

Please read each statement and circle a number 0, 1, 2, 3 or 4 which indicates how much the statement applied to you *within the last week*. There are no right or wrong answers.

The rating scale is as follows:
0 = Never
1 = Almost never
2 = Sometimes
3 = Fairly often
4 = Very often

1. Recently, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. Recently, how often have felt that you were unable to control the important things in your life?	0	1	2	3	4
3. Recently, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. Recently, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. Recently, how often have you felt that things were going your way?	0	1	2	3	4
6. Recently, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. Recently, how often have you been able to control irritations in your life?	0	1	2	3	4
8. Recently, how often have you felt that you were on top of things?	0	1	2	3	4
9. Recently, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. Recently, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *within the last week.* There are no right or wrong answers.

The rating scale is as follows:
0 = Does not apply to me at all
1 = Applies to me to some degree, or some of the time
2 = Applies to me to a considerable degree, or a good part of time
3 = Applies to me very much, or most of the time

1. Recently, I found it hard to wind down	0 1 2 3
2. Recently, I was aware of dryness of my mouth	0 1 2 3
3. Recently, I can not seem to experience any positive feeling at all	0 1 2 3
4. Recently, I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0 1 2 3
5. Recently, I found it difficult to work up the initiative to do things	0 1 2 3
6. Recently, I tend to over-react to situations	0 1 2 3
7. Recently, I experienced trembling (eg, in the hands)	0 1 2 3
8. Recently, I felt that I was expressing a lot of nervousness	0 1 2 3
9. Recently, I was worried about situations in which I might panic and make a fool out of myself	0 1 2 3
10. Recently, I felt that I had nothing to look forward to	0 1 2 3
11. Recently, I find myself getting agitated	0 1 2 3
12. Recently, I find it difficult to relax	0 1 2 3
13. Recenlty, I felt down-hearted and blue	0 1 2 3
14. Recently, I have been intolerant of anything that kept me from getting on with what I was doing	0 1 2 3

Survey continued:

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *within the last week.* There are no right or wrong answers.

15. Recently, I felt I was close to panic	0	1	2	3
16. Recently, I was unable to become enthusiastic about anything	0	1	2	3
17. Recently, I felt I was not worth much as a person	0	1	2	3
18. Recently, I felt that I was rather sensitive	0	1	2	3
19. Recently, I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20. Recently, I felt scared without any good reason	0	1	2	3
21. Recently, I felt that life was meaningless	0	1	2	3

APPENDIX B: PILOT STUDY QUESTIONAIRE

Feedback Questions

1. Which biomes did you enjoy being in the most?
    a. Why did you enjoy that biome?

2. How realistic did the environment feel based on your experience in nature?

3. Was there some place you wanted to go but couldn't?
    a. What space was it?
    b. Why couldn't you get to it?

4. Did you find this experience relaxing?
    a. What made it relaxing?
    b. (If not) what could have made it relaxing?
    c. Did the animals contribute?
    d. Did the fantasy elements contribute?
    e. Did the lighting effects (pools of light, diffused light, reflections) contribute?

APPENDIX C: CONSENT FORM

I am asking you to participate in a research study titled “Experience and Exposure: Virtual Reality as a Conduit for Active Mediation”. This study is being led by Erik Swanson, Department of Interior Architecture at the University of North Carolina at Greensboro. The **Faculty Advisor for this study is** Amanda Gale, Department of Interior Architecture at the University of North Carolina at Greensboro.

Purpose:

The purpose of this research is to determine if active meditation in a virtual setting has the same benefits as physical active meditation with aiding in reducing higher education students stress.

Procedures:

I will ask you to spend time in a virtual space modeled after nature which will take no more than 45 minutes of your time two times in one week. You will have the freedom to explore the space how you see fit. You will take a survey at the beginning of the first session which includes the perceived stress scale (PSS) and the Depression Anxiety Stress Scale (DASS), and the same survey at the end of the second session. These surveys will help determine you the participants perceived stress depression and anxiety.

Risks and discomforts:

While being rare occurrences, people may experience the following in the virtual space and survey

- *Dizziness or nausea*
- *Eye strain*
- *Headaches*
- *Some survey questions may induce emotional reactions*

If you the participant is affected by the survey in any way, please utilize the contact below:

Anna M. Gove Student Health Center 107 Gray Drive
336-334-5340

Benefits:
Benefits from participating can include, a reduction in perceived stress

Compensation for participation:
There is no compensation for participating

Privacy/Confidentiality/Data Security:
The surveys will not list participants names other than a given code. Only myself and my committee chair will know which codes pair to which names of the participants. All signed consent forms will be kept separate from the survey data and the two will not be connected. All data will be stored on a password protected BOX file on a password protected computer. All information obtained in this study is strictly confidential unless disclosure is required by law.

Sharing De-identified Data Collected in this Research:
De-identified data from this study may be shared with the research community at large to advance science and health. We will remove or code any personal information that could identify you before files are shared with other researchers to ensure that, by current scientific standards and known methods, no one will be able to identify you from the information we share. Despite these measures, we cannot guarantee anonymity of your personal data.

Voluntary nature of the study:

Participation in this study is voluntary. If you decide to participate, you are free to withdraw at any time without penalty.

Contact and Questions:

Erik Swanson (easwanso@uncg.edu) and Dr Amanda Gale (ajgale@uncg.edu) will be happy to answer any questions you have regarding the study. If you have any concerns about your rights, how you are being treated, concerns or complaints about this project or benefits or risks associated with being in the study please contact the Office of Research Integrity at UNCG toll-free at (855)251-2351.

Statement of Consent:

I have read the above information and have received answers to any questions I asked. I consent to take part in the study.

Your Signature_____ Date_____

Your Name (printed)_____

Signature of person obtaining consent_____ Date_____

Printed name of person obtaining consent_____

This consent form will be kept by the researcher for five years beyond the end of the study.

APPENDIX D: IRB APPROVAL LETTER

OFFICE OF RESEARCH INTEGRITY
2718 Beverly Cooper Moore and Irene Mitchell Moore
Humanities and Research Administration Bldg.
PO Box 26170
Greensboro, NC 27402-6170
336.256.0253
Web site: www.uncg.edu/orc
Federalwide Assurance (FWA) #216

To: Erik Swanson
Interior Architecture
swansonea1@gmail.com

From: UNCG IRB

Authorized signature on behalf of IRB

Approval Date: 11/12/2019
Expiration Date of Approval: 11/11/2020

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Submission Type: Initial
Expedited Category: 4.Noninvasive clinical data,7.Surveys/interviews/focus groups
Study #: 20-0143
Study Title: Experience and Exposure: Virtual Reality as a Conduit for Active Meditation

This submission has been approved by the IRB for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Study Description:

The intent of the project was to develop a virtual mediation space based on the complementary concepts of biophilia and Stress Reduction Theory. The virtual mediation space is aimed at helping college students manage stress. The test space was designed around the elements of biophilia which include, refuge, risk/peril, prospect and mystery, organic shapes and feature, diffused light effects, pools of light, light reflection and light bloom/glow effects. The inclusion of biophilic lighting elements such as reflection, diffused light, and light pools derived from phototropism, which is living organisms' innate attraction to light.

Investigator's Responsibilities

Signed letters will be scanned to you in a separate email. **Please utilize the the consent form/information sheet with the most recent version date when enrolling participants.** Please be aware that any changes to your protocol must be reviewed by the IRB prior to being implemented.

Please be aware that valid human subjects training and signed statements of confidentiality for all members of research team need to be kept on file with the lead investigator. Please note that you will also need to remain in compliance with the university "Access To and Retention of Research Data" Policy which can be found at http://policy.uncg.edu/university-policies/research_data/.